



Utilizing Doppler Ultrasound to Detect Blood Flow within the Median Nerve

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INTRODUCTION

- Repetitive motion injuries have been related to occupational exposure.¹
- Up to 90% of Diagnostic Medical Sonographers (DMS) scan in pain and up to 20% will eventually experience a career ending injury.¹
- Imaging the nerve allows for expedient evaluation of the nerve and associated pathology.²
- Hand Carried Ultrasound (HCU) has the potential to reduce costs, improve speed, and promote worksite evaluation.³
- Diagnostic values for median nerve pathology have been described, but no research has been completed on the vascular perfusion of the neural sheath.^{4,5}

RESEARCH OBJECTIVES

Primary

- To determine if arteriole blood flow could be detected and quantified by the use of power and spectral Doppler sonography within the median neural sheath

Secondary

- To calculate the pulsatility and resistive indices of the spectral Doppler waveform and find any statistical significance between pre and post exercise

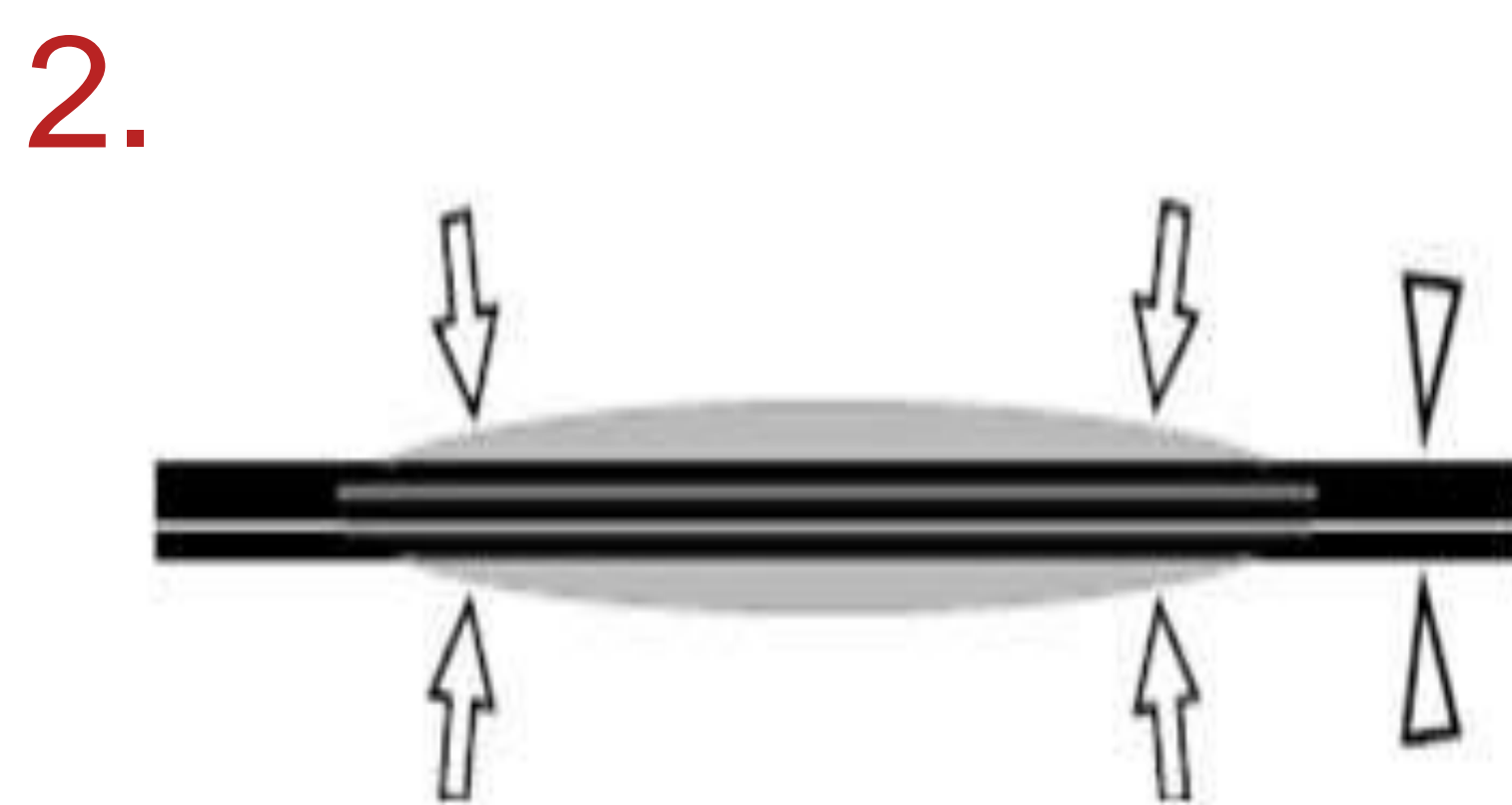
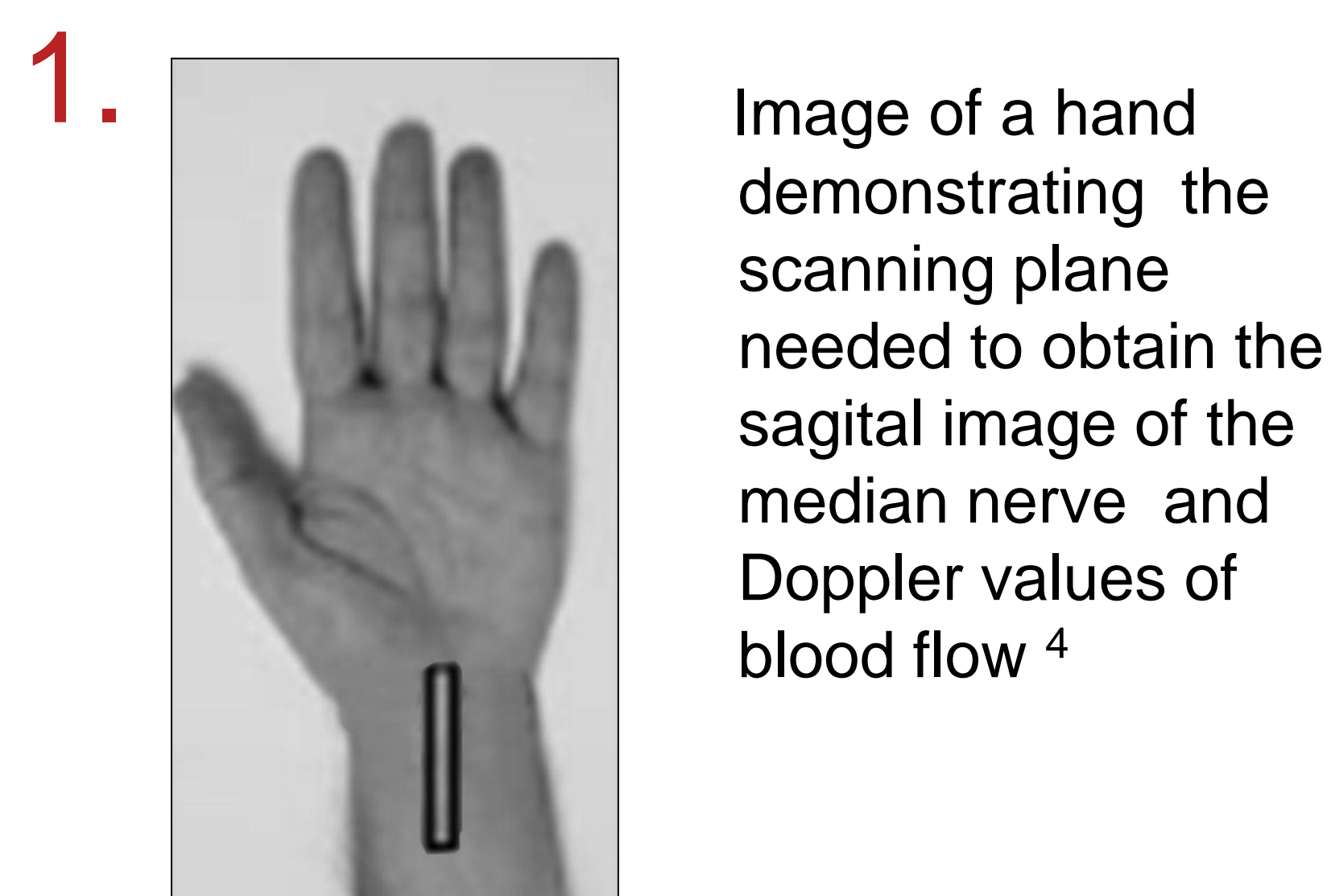
EQUIPMENT & SETTINGS

- **HCU:** GE Healthcare Logiq i (Milwaukee, WI)
- **Transducer:** 12-MHz linear
- **Depth:** 3 cm
- **Overall Gain:** 65 dB
- **TGC:** Vertical & Centered
- **Power Doppler Gain:** 14-21 dB
- **Power Doppler PRF:** 0.4-0.6 kHz
- **Spectral Doppler Gain:** 26-32 dB
- **Spectral Doppler PRF:** 2.6 kHz
- **Spectral Doppler sample volume:** 2 mm
- **Processing:** Harmonics and CrossBeam® Technology

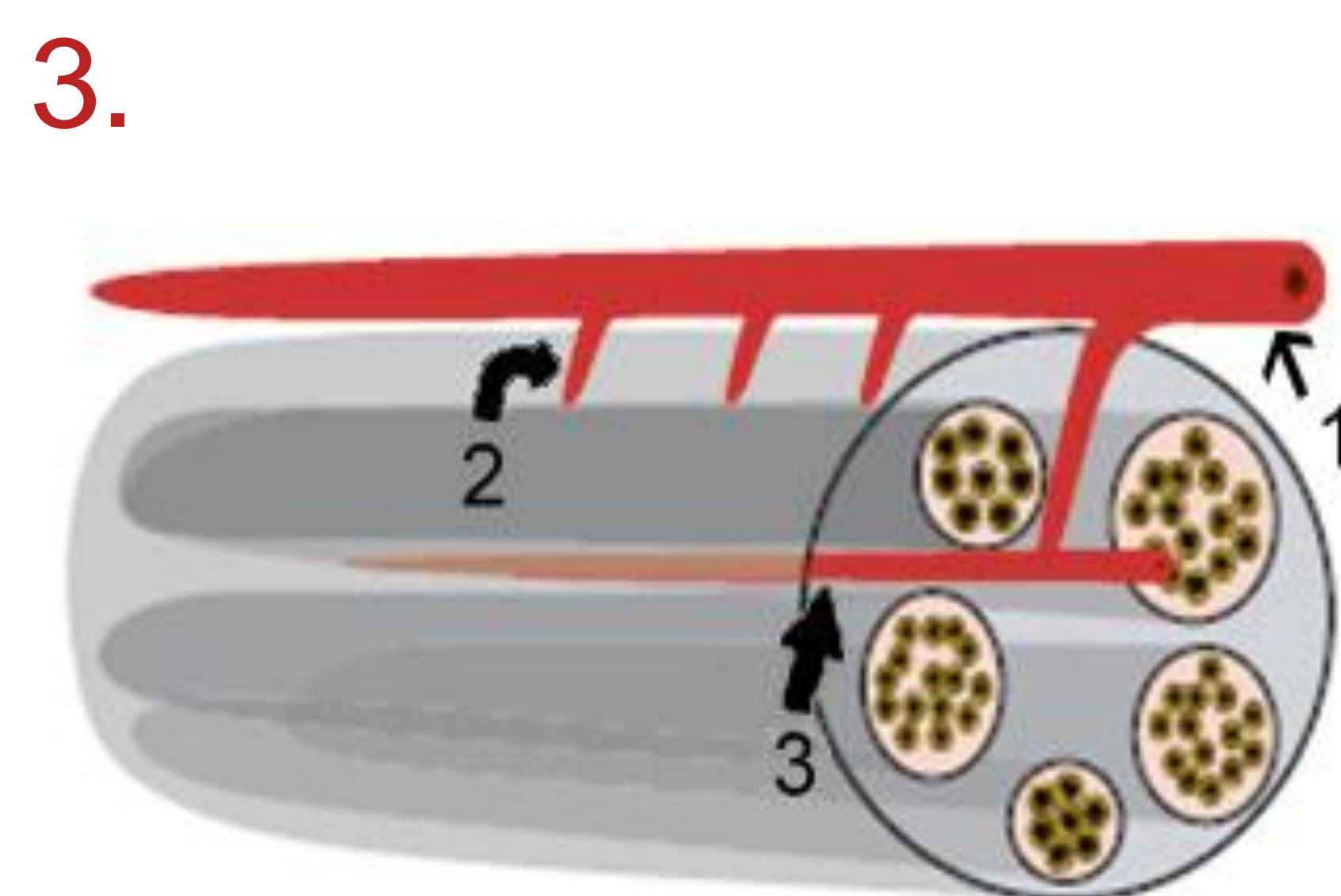
METHODOLOGY

- Five DMS were recruited for this feasibility study. Ultrasound measurements were taken on both wrists before and after exercise (threshold of three neonatal brain sonographic exams) over a 10-week period.
- The subjects sat facing the examiner with the shoulder slightly flexed, elbow extended, forearm supinated, forearm and wrist rested comfortably on a flat surface, the wrist in neutral and the fingers relaxed in a natural semi-flexed position.
- A longitudinal grayscale image of the median nerve was taken at the level of the pisiform (proximal carpal tunnel). Power Doppler, being the most sensitive to flow, was then utilized to document low blood flow in and around the neural sheath.
- Once this low blood flow was found with power Doppler, the spectral Doppler gate was put over the most consistent flow and a spectral waveform was obtained. Quantitative measurements including peak systole (PS) and end diastole (ED) were then taken from this information. Resistive and Pulsatile Indices (RI & PI) were calculated .

ANATOMY

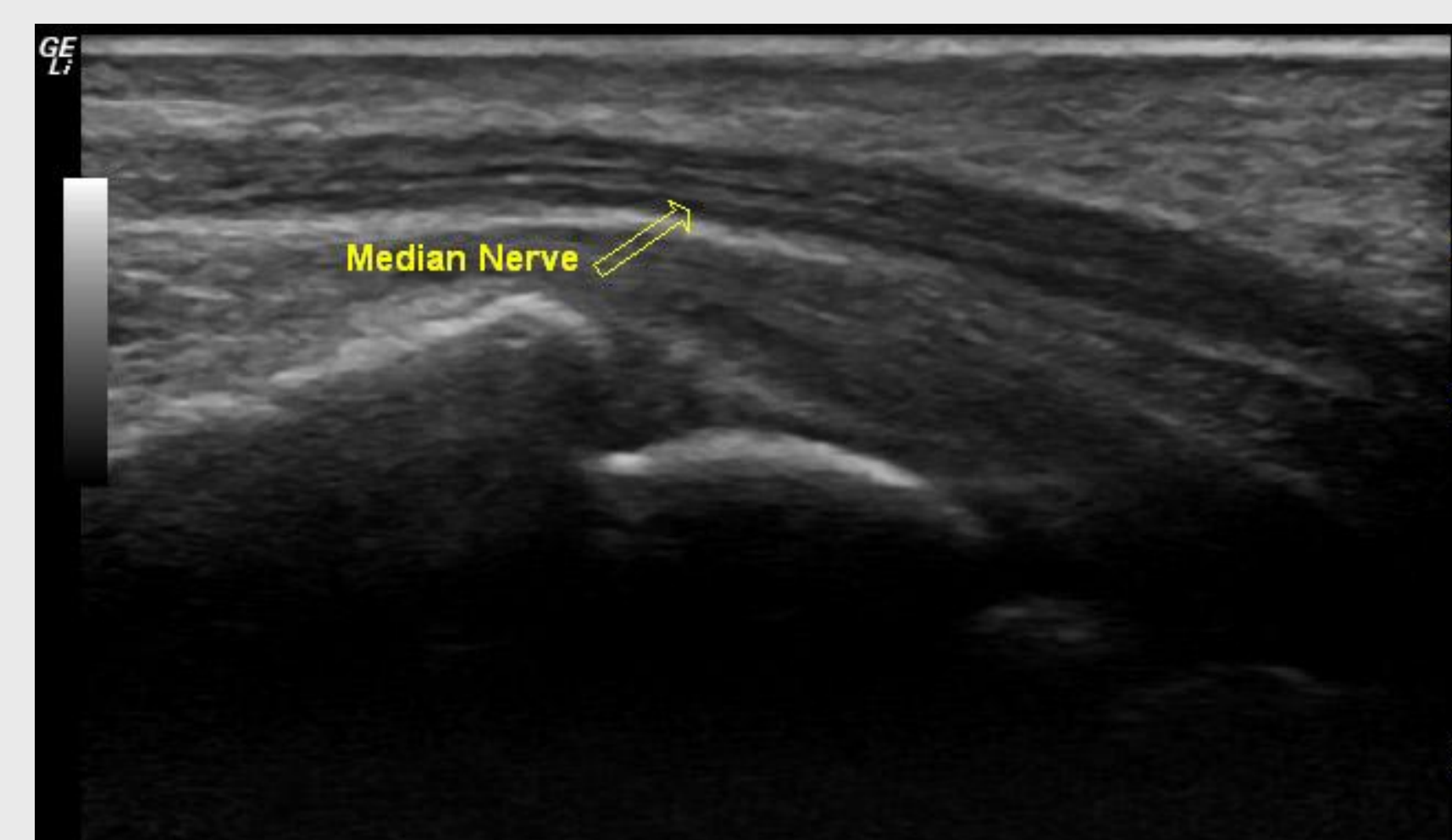


Schematic drawing of an acute insult to the median nerve demonstrating swelling around the nerve and fascicles.⁴

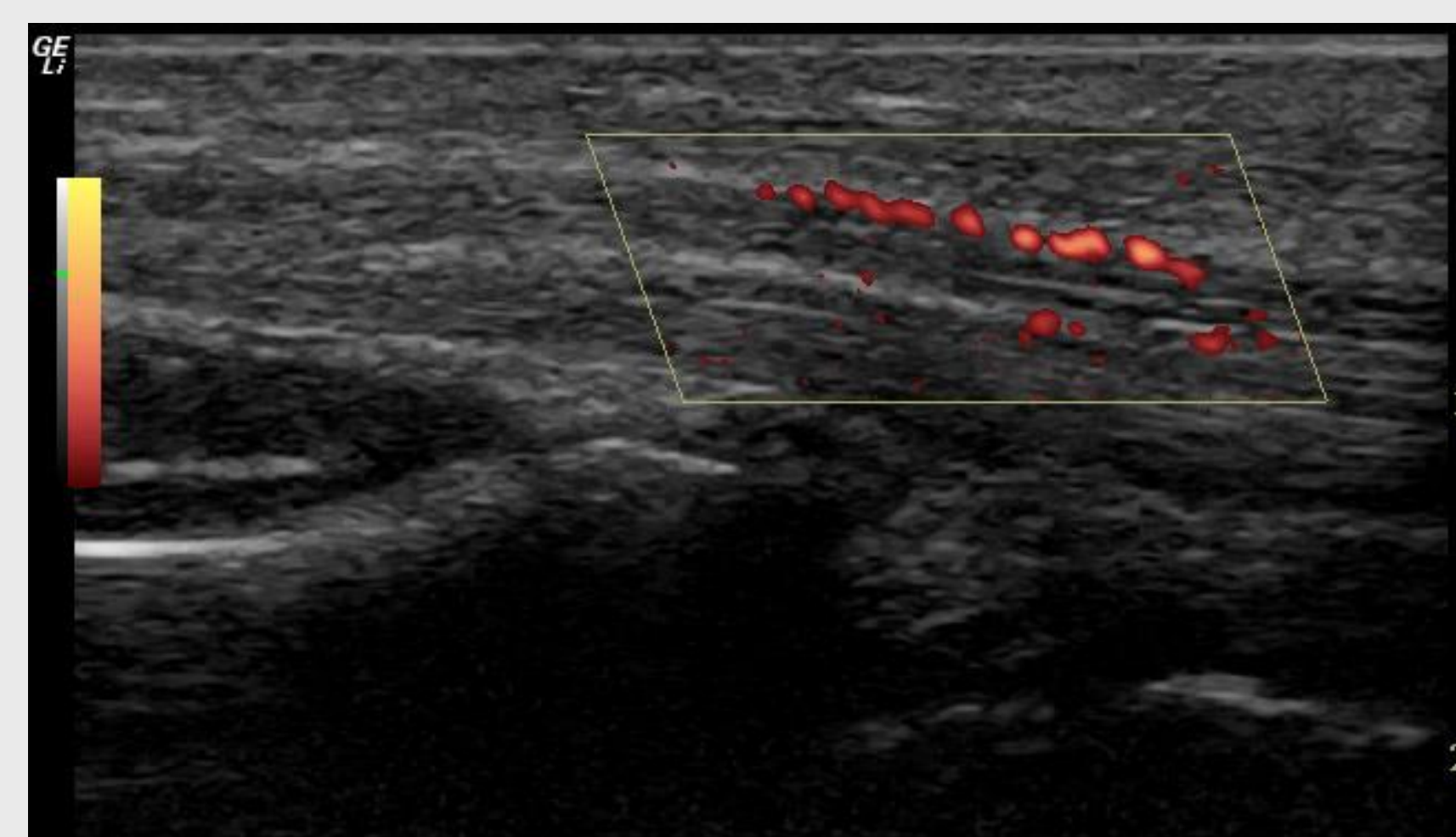


- 1) Perineural vessels coursing along the nerve
- 2) Branches which pierce the outer epineurium
- 3) Microvasculature among the neural fascicles.⁴

ULTRASOUND IMAGES



Long-axis grayscale image of the median nerve (radius (left) and pisiform (right) landmarks also shown below the nerve)



Power Doppler indicating low blood flow within the median nerve sheath



Duplex image showing power Doppler and the spectral Doppler waveform in the median nerve sheath

RESULTS

A total of 84 Doppler wrist examinations were performed on 10 wrists in 5 subjects.

Power Doppler Data

A qualitative analysis was obtained from every exam or 100% of the time showing very low blood flow.

Spectral Doppler Data

A quantitative analysis was obtained only half of the time (42/84).

No statistical significance (P -value ≥ 0.05) was found between pre and post measurements of the right hand - PS(0.96), ED (0.25), RI (0.12) or PI (0.18). The very low blood flow can be seen by the total averages below:

Average PS = 4.36 cm/sec
Average ED = 0.76 cm/sec
Average RI = 0.83
Average PI = 2.97

CONCLUSIONS

HCU is a feasible imaging method for detection of vascular flow in the median nerve sheath, however, power Doppler was more consistent than spectral Doppler.

Limitations existed for spectral Doppler sensitivity when using the HCU. A more sophisticated ultrasound unit may provide more favorable results.

Studies with a larger sample size and a longitudinal approach are necessary to determine measurement/protocol reliability.

Further investigation of Doppler waveforms in the median nerve sheath is warranted to determine diagnostic and/or research uses.

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